The Declining Raymond Basin and the Arroyo Seco Canyon Project

Ken Kules, PE

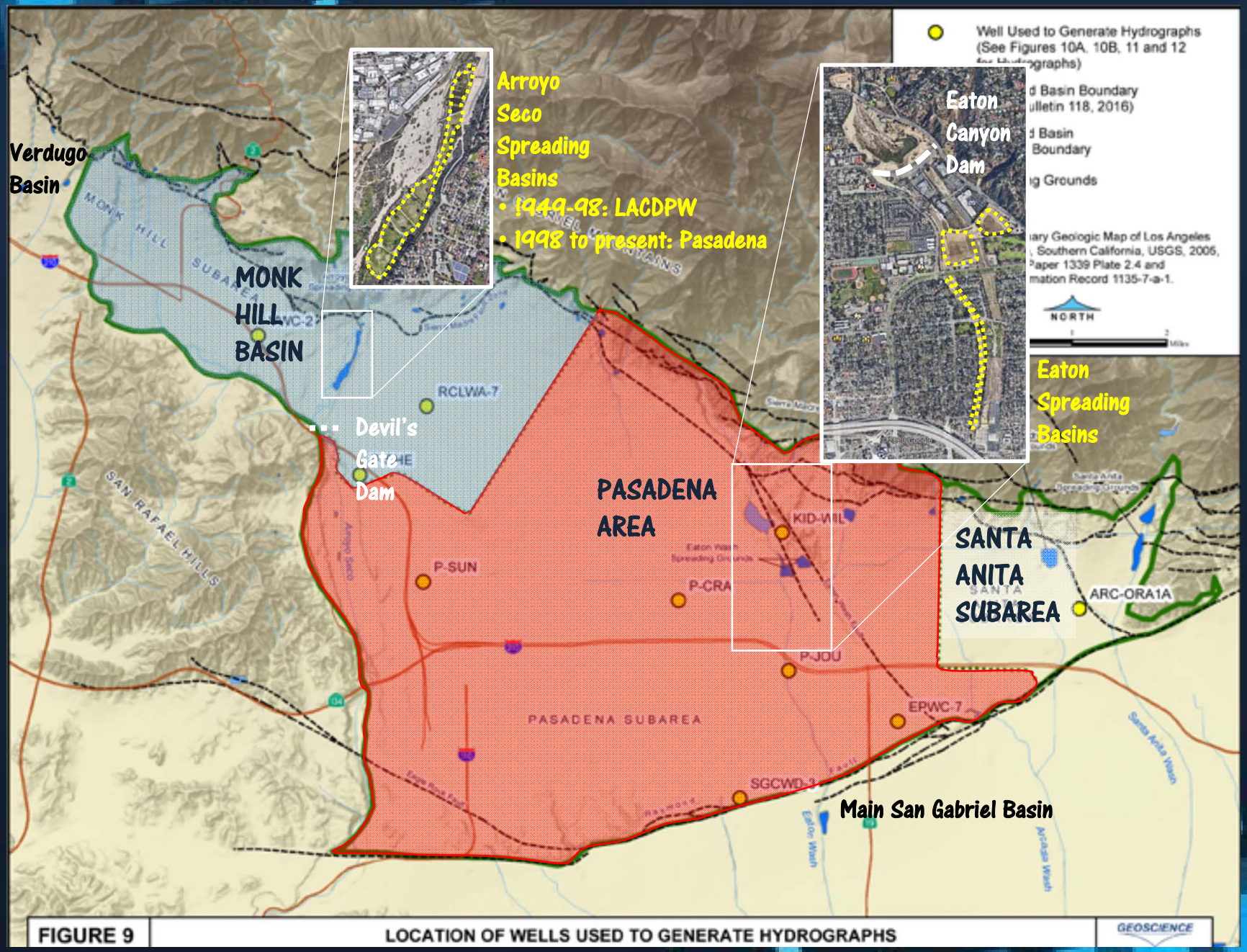
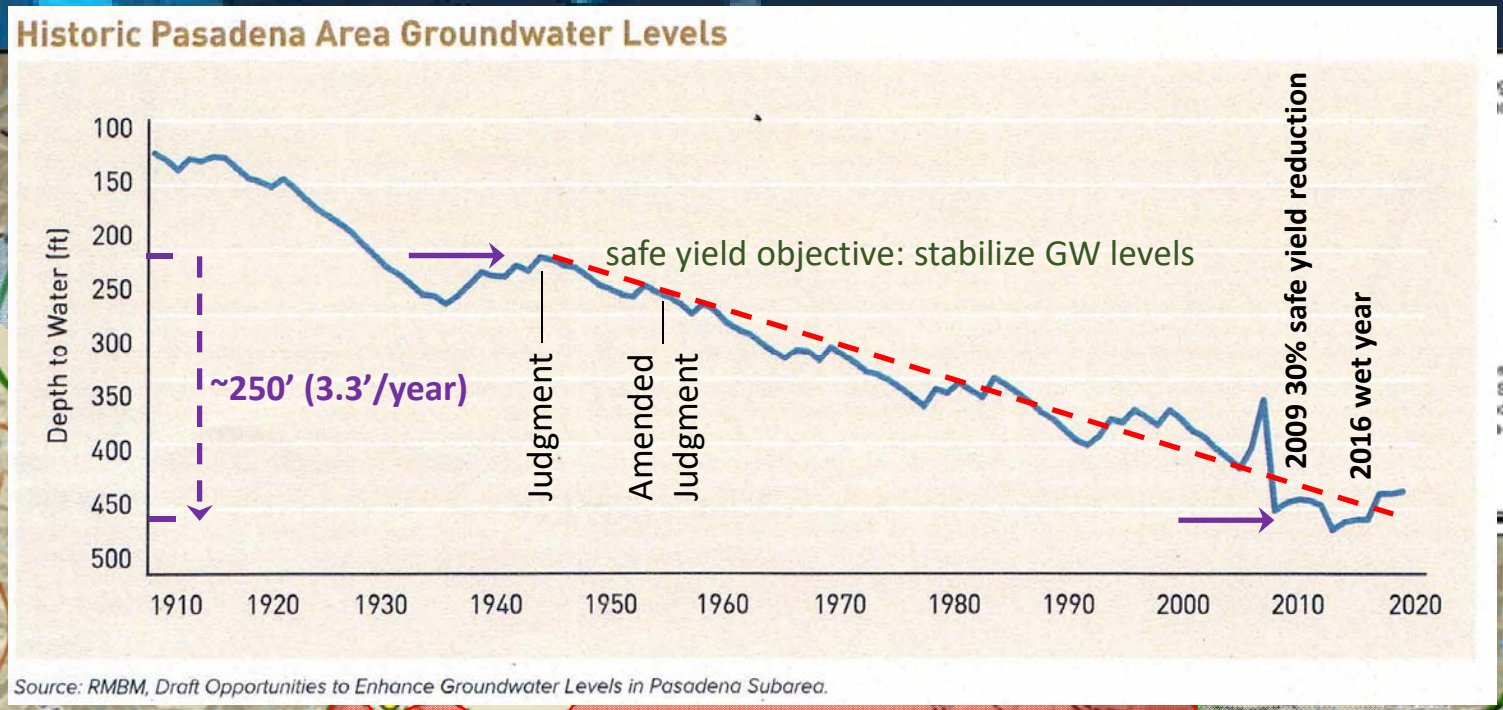


FIGURE 9 LOCATION OF WELLS USED TO GENERATE HYDROGRAPHS GEOSCIENCE


Historic Pasadena Area Groundwater Levels
Depth to Water (ft)
100
150
200
250
300
350
400
450
500
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
~250' (3.3'/year)
Judgment
Amended Judgment
safe yield objective: stabilize GW levels
2009 30% safe yield reduction
2016 wet year
Source: RMBM, Draft Opportunities to Enhance Groundwater Levels in Pasadena Subarea.

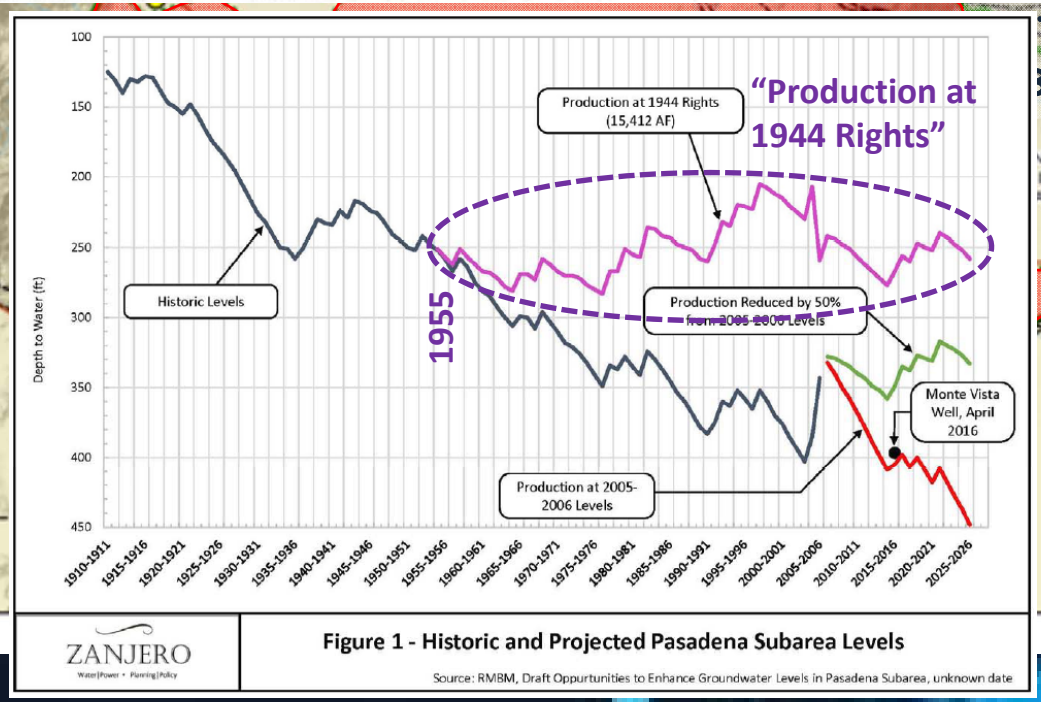
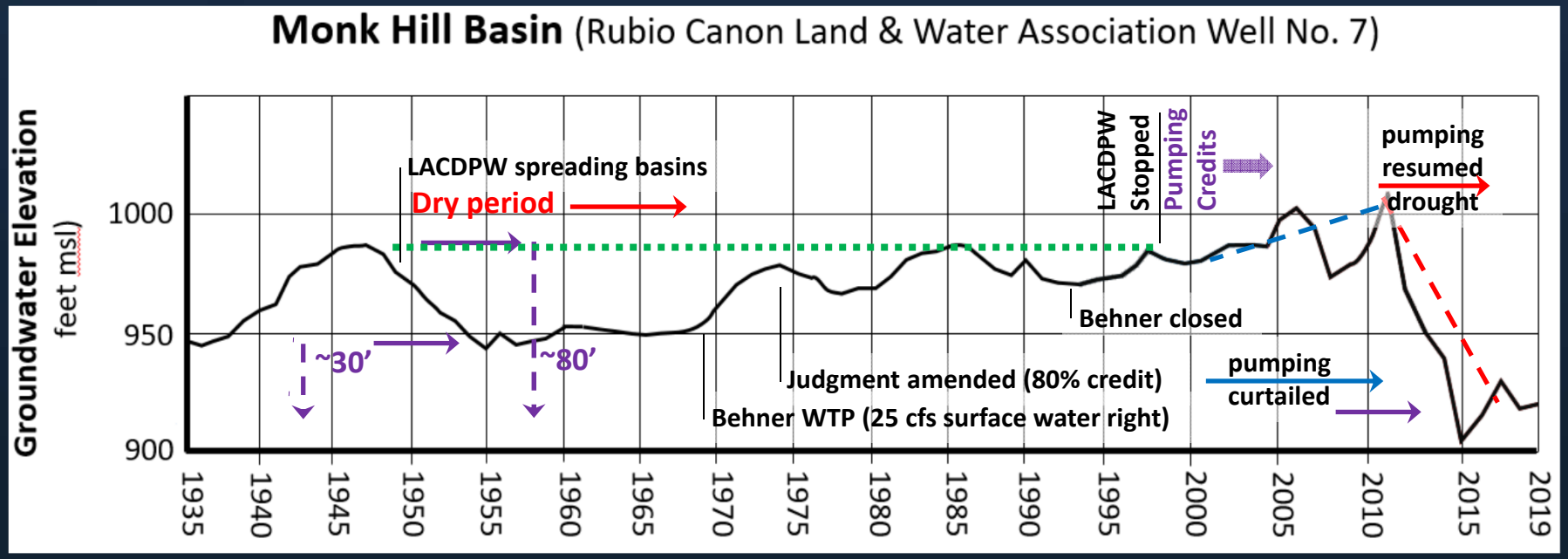

Depth to Water (ft)
100
150
200
250
300
350
400
450
1910-1911
1915-1916
1920-1921
1925-1926
1930-1931
1935-1936
1940-1941
1945-1946
1950-1951
1955-1956
1960-1961
1965-1966
1970-1971
1975-1976
1980-1981
1985-1986
1990-1991
1995-1996
2000-2001
2005-2006
2010-2011
2015-2016
2020-2021
2025-2026
Production at 1944 Rights (15,412 AF)
"Production at 1944 Rights"
Historic Levels
1955
Production Reduced by 50% from 2005-2006 Levels
Monte Vista Well, April 2016
Production at 2005-2006 Levels
ZANJERO
Water|Power • Planning|Policy
Figure 1 - Historic and Projected Pasadena Subarea Levels
Source: RMBM, Draft Oppurtunities to Enhance Groundwater Levels in Pasadena Subarea, unknown date

FIGURE 9

Monk Hill Basin



How groundwater recharge is managed

Judgment provision for recharging with surface water rights & pumping credits

- Pumping credit to water rights holder for 80% of water recharged allocation
- Remainder 20% goes to benefit the basin

RBMB "rule" for recharging other than surface water rights

- Pumping credit to recharger for 60% of water recharged
- Remainder 40% goes to benefit the basin

All water recharged by LACDPW goes to benefit the basin

- Eaton Canyon
- Arroyo Seco (prior to 1998)

WSRP

Projects that depend on diverted water

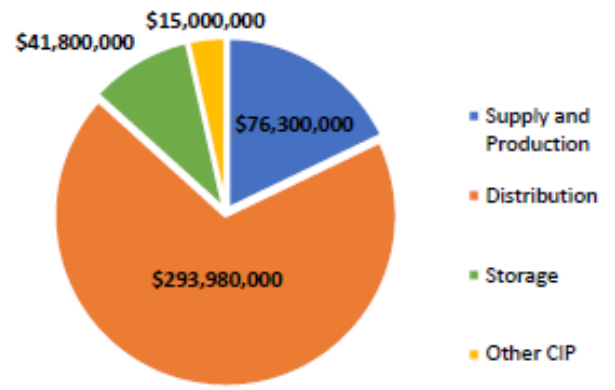
Arroyo Seco diversion/spreading basins
Deliver diverted water to Pasadena Area
Pump water from behind Devil's Gate

Deliver high NO3 & diverted water for irrigation

Well replacement & water quality issues

Table 7-6: Portfolio F - Maximize Value of Groundwater/Non-Potable Supplies

Category	Capital Cost
Supply & Production	76,300,000
Distribution	293,980,000
Storage	41,800,000
Other CIP	15,000,000
Total	432,680,000



Supply and Production

Option	Supply and Production Program Components	Capital Cost
IW-0	Treated Imported Water from MWD	0
IW-2	Pasadena Groundwater Storage Program	$16,000,000
LSW-0	Arroyo Seco Canyon Project	$7,400,000
LSW-00	Arroyo Seco to Eaton Canyon Raw Water Pipeline	$6,600,000
LSW-1	Arroyo Seco Pump Back Project	$4,000,000
LSW-5	Natural infrastructure	0
NP-3	Local Non-Potable Project	$10,000,000
WUE-1	Conservation Programs to Meet Future Regulations Plus 10% Additional Outdoor Conservation	$12,000,000
Base GW	Current Groundwater Production	0
GW-0	Well Projects, Importance Level 1	$6,500,000
GW-00	Well Projects, Importance Level 2	$400,000
GW-2a	Add Nitrate Treatment to the Monk Hill Wells	$7,500,000
GW-2b	Nitrate, Perchlorate and VOC Treatment to the Sunset Wells	$2,900,000
GW-3	Connect High Nitrate Wells to a Local Non-Potable System – in conjunction with NP-3	$3,000,000
	Total	$76,300,000

?

?

?

WSRP, p. 7-13

Arroyo Seco diversion & spreading

Arroyo Seco Canyon Project

FEIR hearing January 6

* Obermyer weir

ARROYO SECO CANYON PROJECT

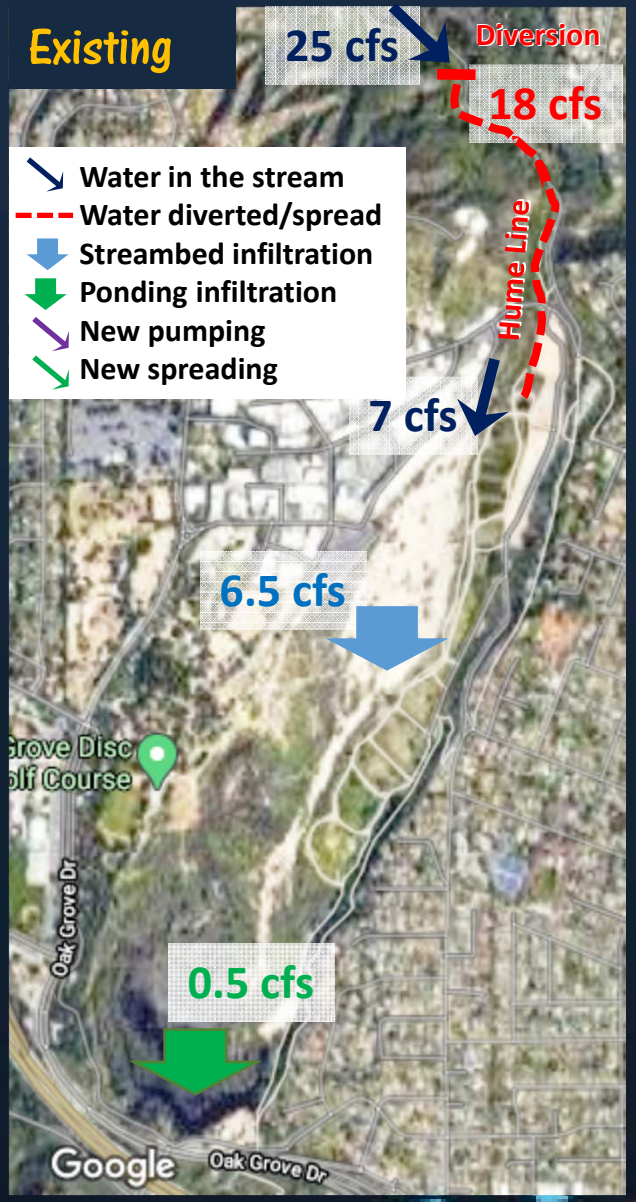
Pasadena Water & Power: the increment of water captured by the ASCP would not have percolated behind Devil's Gate Dam

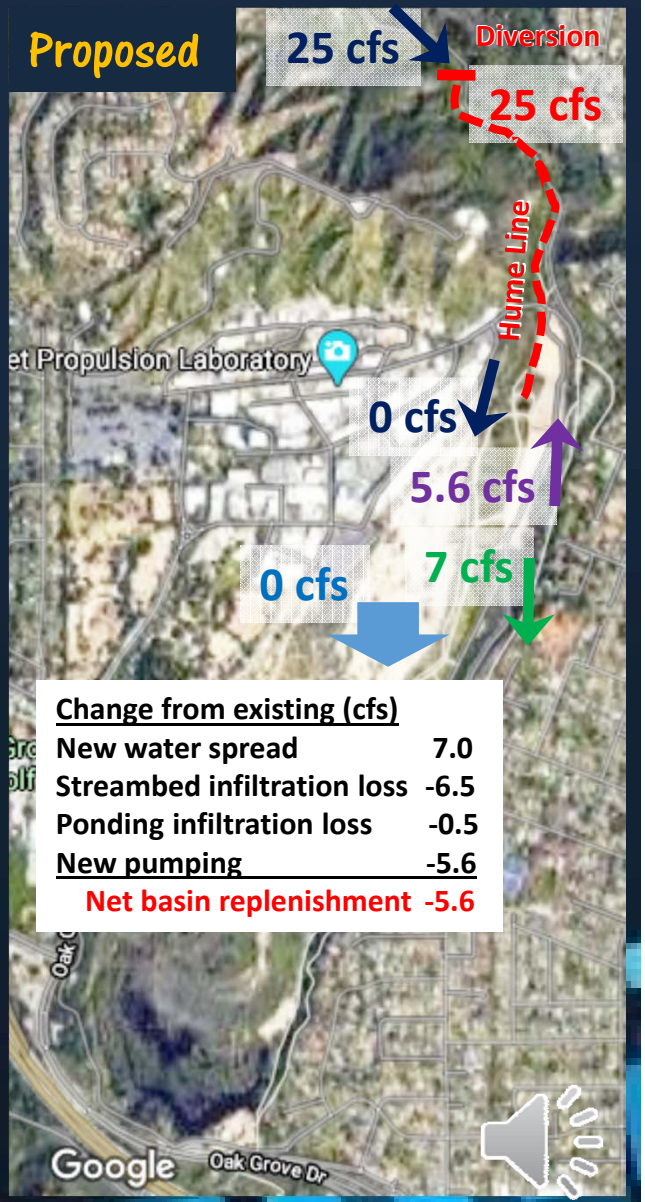
Key factors:

- Streambed infiltration capacity: 6.5 cfs*
- Ponding infiltration capacity: 25-29 cfs**
- "Big Dig" settlement: ponding at Devil's Gate through June

* Philip Williams Associates (2000)

** PWA (2000) & PWP's 2011 WIRP (CDM)





Change from existing (cfs)	
New water spread	7.0
Streambed infiltration loss	-6.5
Ponding infiltration loss	-0.5
New pumping	-5.6
Net basin replenishment	-5.6

How does this translate to groundwater impacts?

Operations Model

1 cfs/day = 1.98347 AF/day

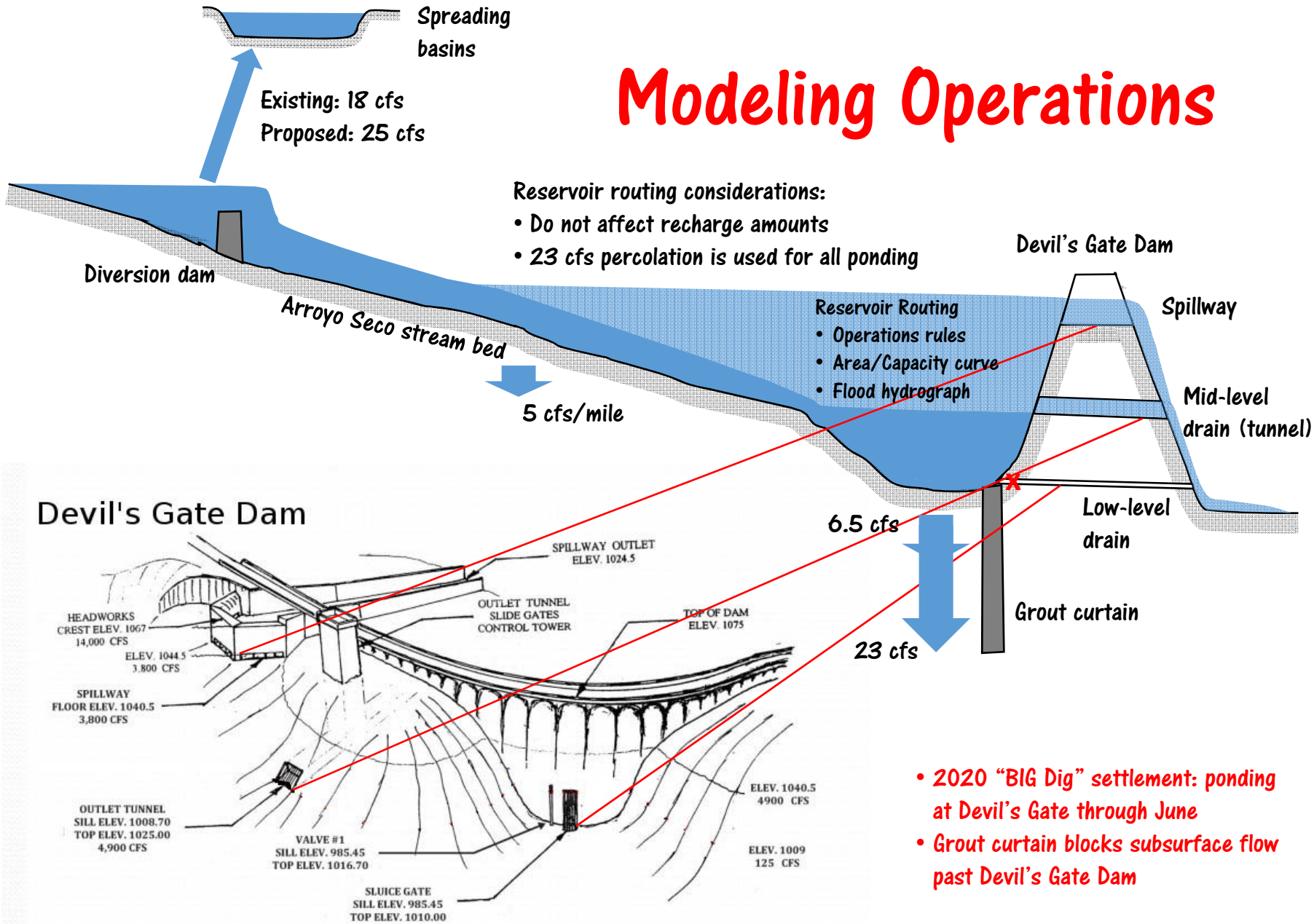
USGS Gage

1990 thru 2019

Operating assumptions

Date	Arroyo Seco gage mean daily flow (cfs)	0-25 (proposed - includes existing) cfs	0-25 (proposed - includes existing) AF/day	0-25 cfs (model method: diversions stop at 25 cfs; max 18 cfs diversion) cfs	0-25 cfs (model method: diversions stop at 25 cfs; max 18 cfs diversion) AF/day	0-25 cfs (DEIR method: diversions stop at 25 cfs; max 25 cfs diversion) cfs	0-25 cfs (DEIR method: diversions stop at 25 cfs; max 25 cfs diversion) AF/day	18-25 cfs (proposed project incremental diversions) cfs	18-25 cfs (proposed project incremental diversions) AF/day	18-38 cfs (existing condition, PWA low percolation estimate) cfs	18-38 cfs (existing condition, PWA low percolation estimate) AF/day	18-43 cfs (existing condition, PWA high percolation estimate) cfs	18-43 cfs (existing condition, PWA high percolation estimate) AF/day	18-38 cfs (propos condition, PW low percolatio estimate) cfs	18-38 cfs (propos condition, PW low percolatio estimate) AF/da
1/1/1990	0.43	0.43	0.9	0.43	0.9	0.43	0.9	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/2/1990	0.65	0.65	1.3	0.65	1.3	0.65	1.3	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/3/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/4/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/5/1990	0.49	0.49	1.0	0.49	1.0	0.49	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/6/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/7/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/8/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/9/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/10/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/11/1990	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/12/1990	0.52	0.52	1.0	0.52	1.0	0.52	1.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/13/1990	7.4	7.4	14.7	7.4	14.7	7.4	14.7	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/14/1990	17	17	33.7	17	33.7	17	33.7	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/15/1990	4.8	4.8	9.5	4.8	9.5	4.8	9.5	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/16/1990	3.8	3.8	7.5	3.8	7.5	3.8	7.5	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/17/1990	9.8	9.8	19.4	9.8	19.4	9.8	19.4	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/18/1990	4.1	4.1	8.1	4.1	8.1	4.1	8.1	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/19/1990	2.7	2.7	5.4	2.7	5.4	2.7	5.4	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/20/1990	2.1	2.1	4.2	2.1	4.2	2.1	4.2	0.00	0.0	0.00	0.0	0.00	0.0	0.00	
1/21/1990	1.8	1.8	3.6	1.8	3.6	1.8	3.6	0.00	0.0	0.00	0.0	0.00	0.0	0.00	

Modeling Operations



Reservoir routing considerations:

- Do not affect recharge amounts
- 23 cfs percolation is used for all ponding

Reservoir Routing

- Operations rules
- Area/Capacity curve
- Flood hydrograph

- 2020 "BIG Dig" settlement: ponding at Devil's Gate through June
- Grout curtain blocks subsurface flow past Devil's Gate Dam

How does this translate to groundwater impacts?

Description	Existing (AF/Y)	Proposed (AF/Y)
Diverted & replenished at spreading basins		
- Existing (baseline)	1,973	1,973
- ASCP increment	N/A	1,104
Percolation behind Devil's Gate Dam (stream-bed & ponding)	1,206	433
New groundwater pumping (depletion)	N/A	(-)883
Net effect on groundwater:	3,179	2,627

+331 AF/Y

552 AF/Y (7.4% of safe yield) will be lost from the Monk Hill basin!

10	1/6/1990	0.5	0.5										0.00	0.0	0.00
11	1/7/1990	0.5	0.5										0.00	0.0	0.00
12	1/8/1990	0.5	0.5										0.00	0.0	0.00
13	1/9/1990	0.5	0.5										0.00	0.0	0.00
14	1/10/1990	0.5	0.5										0.00	0.0	0.00
15	1/11/1990	0.5	0.5										0.00	0.0	0.00
16	1/12/1990	0.52	0.52										0.00	0.0	0.00
17	1/13/1990	7.4	7.4	14.7	7.4	14.7	7.4	14.7	0.00	0.0	0.00	0.0	0.00	0.0	0.00
18	1/14/1990	17	17	33.7	17	33.7	17	33.7	0.00	0.0	0.00	0.0	0.00	0.0	0.00
19	1/15/1990	4.8	4.8	9.5	4.8	9.5	4.8	9.5	0.00	0.0	0.00	0.0	0.00	0.0	0.00
20	1/16/1990	3.8	3.8	7.5	3.8	7.5	3.8	7.5	0.00	0.0	0.00	0.0	0.00	0.0	0.00
21	1/17/1990	9.8	9.8	19.4	9.8	19.4	9.8	19.4	0.00	0.0	0.00	0.0	0.00	0.0	0.00
22	1/18/1990	4.1	4.1	8.1	4.1	8.1	4.1	8.1	0.00	0.0	0.00	0.0	0.00	0.0	0.00
23	1/19/1990	2.7	2.7	5.4	2.7	5.4	2.7	5.4	0.00	0.0	0.00	0.0	0.00	0.0	0.00
24	1/20/1990	2.1	2.1	4.2	2.1	4.2	2.1	4.2	0.00	0.0	0.00	0.0	0.00	0.0	0.00
25	1/21/1990	1.8	1.8	3.6	1.8	3.6	1.8	3.6	0.00	0.0	0.00	0.0	0.00	0.0	0.00

The Effects of Groundwater Overdraft

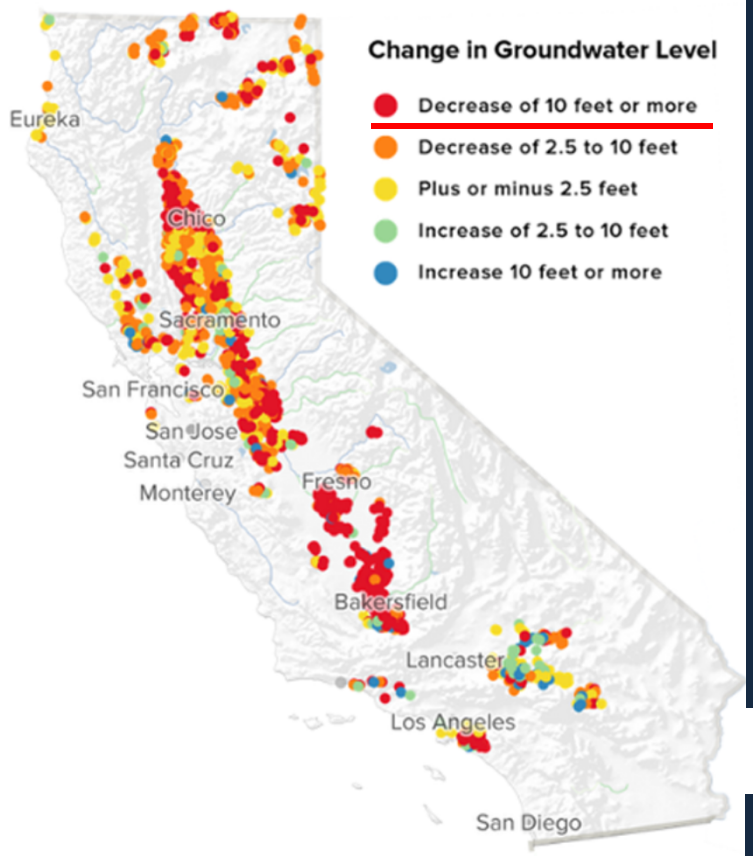
Pasadena Area: ~33 feet/decade
Monk Hill: ~80 feet/decade

Direct impacts of groundwater overdraft include reduced water supply due to aquifer depletion or groundwater contamination, increased groundwater pumping costs, and the costs of well replacement or deepening. An increasing number of people with domestic wells are seeing them dry up, leading to conflicts. Rural landowners and small-scale farmers are disproportionately affected by overdraft as they have fewer financial resources to dig new or deeper wells or diversify their water supply.

Less obvious are the indirect consequences of groundwater overdraft, which include land subsidence and infrastructure damage, harm to groundwater-dependent ecosystems, and the economic losses from a more unreliable water supply for California.

Many of these impacts are not exclusive to groundwater overdraft. But overdraft will generally exacerbate pre-existing conditions or create new ones entirely.

Change in Groundwater Levels During the...



Groundwater level changes reflect difference between Spring 2004 to Spring 20
(past decade), and Spring 2013 to Spring 2014 (past year).

Source: Groundwater Information Center, California Department of Water Resc

Direct Impacts
- Reduced water supply
- Increased pumping cost
- Water quality impacts magnified
- Cost of well replacement

Indirect impacts
- Land subsidence
- Infrastructure damage
- Harm to groundwater-dependent ecosystems
- Economic losses from a more unreliable water supply

Pasadena Wells
- Elevated TDS & nitrates
- Wells require replacement(?)

https://waterinthewest.stanford.edu/groundwater/overdraft/

Recent ASCP History/Projected Schedule*

- DEIR circulated June 15, 2020
- DEIR comments deadline July 31, 2020
- FEIR status report to MSC October 27, 2020
- WSRP EAC briefing October 27, 2020
- Met with PWP November 13, 2020
- FEIR (w/ responses to comments) December 23, 2020
- CUP/FEIR hearing January 6, 2021**
- FEIR certification mid-January 2021**
- WSRP to MSC January 26, 2021
- WSRP to City Council February 8, 2021

* All projected dates tentative

** Hearing & FEIR certification by a Hearing Officer (not the City Council)

Existential questions…

- Is it Pasadena's policy to continue drawing the Raymond Basin down?
- If not, what is the plan for "healing" the Raymond Basin?
- Is moving forward with the ASCP without a plan for the Raymond Basin responsible stewardship of the groundwater?

Questions?